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Abstract

Sintered Aluminium Products for Organic Reactor Application

by N. Hansen, P. Knudsen, A. C. Winther, E. Adolph

The Danish Atomic Energy Commission
Research Establishment Risö, Roskilde, Denmark

The Danish Atomic Energy Commission has undertaken a study of an organic-cooled, heavy-water-moderated reactor. Part of this project has been the investigation of sintered aluminium products (SAP), which have been selected for pressure tubes and canning material for the uranium-dioxide fuel.

Sintered aluminium products containing 7 to 11 wt% of aluminium oxide have a satisfactory creep strength at the reactor temperature, but the elongation at creep rupture is very small. Tensile testing of specimens subjected to creep stresses for extended periods has, however, shown satisfactory elongation.

Vacuum degassing of SAP stabilizes the material; thus fissure formation in the microstructure at elevated temperatures is avoided. Extended heat treatment of SAP at 500°C followed by microscopic examination has shown that vacuum-degassed material is completely stable.

Neutron irradiation at 40° and 270°C has a slight effect on the mechanical properties of SAP as examined by tensile and impact testing.

The compatibility between SAP and uranium dioxide is satisfactory. The compatibility between SAP and uranium monocarbide is unacceptable, unless a barrier layer is introduced. Flash welding of SAP canning tubes results in end closures of acceptable tightness and strength. A welding method utilizing a rotating arc is promising for the closing of SAP tubes with aluminium end caps.

Finned tubes of SAP according to the fuel-element design have been successfully extruded by a British manufacturer, and non-destructive methods for measuring the internal diameter and wall thickness of the tubes have been developed.

Alloy development work has resulted in a new type of aluminium/aluminium-oxide material manufactured by mechanical mixing of the constituents. The new alloys have properties comparable to those of SAP, although they are made by a completely different process.